U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF MISSOURI AGRICULTURAL EXPERIMENT STATION, F. B. MUMFORD, DIRECTOR; M. F. MILLER, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF ST. FRANCOIS COUNTY, MISSOURI.

BY

H. H. KRUSEKOPF, IN CHARGE, E. W. KNOBEL, AND C. E. DEARDORFF, OF THE UNIVERSITY OF MISSOURI.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., July 24, 1920.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of St. Francois County, Mo., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1918, as authorized by law. This work was done in cooperation with the University of Missouri Agricultural Experiment Station.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. E. T. MEREDITH,
Secretary of Agriculture.

CONTENTS.

ILLUSTRATIONS.

PLATES.

FIGURE.

MAP.

SOIL SURVEY OF ST. FRANCOIS COUNTY, MISSOURI.

By H. H. KRUSEKOPF, In Charge, E. W. KNOBEL, and C. E. DEARDORFF, of the University of Missouri Agricultural Experiment Station—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

St. Francois County is situated a little north of the southeastern corner of the State, about 45 miles south of St. Louis, and separated by one county from the Mississippi River. It lies in the eastern part of the Missouri Ozark region. The area is 458 square miles, or 293,120 acres.

The surface features of St. Francois County are due almost entirely to differences in the geological structure and relative resistance of the country rocks to weathering and to general stream erosion. Where the hard, igneous rocks and cherty limestones occur the surface is prevailingly hilly and broken, but in the region of the purer limestones and of sandstone the topography is that of a gently rolling plain. The trend or direction of the topographic features is northwestward-southeastward, this being also the general trend of the major geologic divisions. The general slope of the northern half of the country is toward the north, and that of the remainder toward the south. The main watershed or divide is the crest of the Ozark Dome, which extends from Bismarck to the east county line. The elevation above sea level varies from 796 feet at Bonneterre to 941 feet at Knob Lick and 1,024 feet at Bismarck.

FIG. 1.—Sketch map showing location of the St. Francois County area, Missouri.

The county embraces three prominent topographic divisions, which differ in character of soil and in agricultural development. Of these perhaps the most sharply defined is the region of granitic hills known as the St. Francois Mountains. This region, extending east to Knob Lick and north to Simms Mountain south of Elvins, includes all the southwestern part of the county except a small area at Bismarck. It consists of a series of low, dome-shaped and conical hills, locally called mountains, rising to a maximum of about 700 feet above the adjacent country. The more prominent peaks vary from 1,400 to 1,800 feet above sea level. Isolated hills, large and small, pre-

follows: Yelvington 32 feet, Hastings 9 feet, Elkton 33 feet, St. Augustine 5 feet, Sampson 36 feet, and Durbin 62 feet.

West of the principal watershed, which traverses the county in a northwesterly direction, the streams flow west and northwest to the St. Johns River; to the east the drainage is carried eastward and southeastward to the Atlantic Ocean. Comparatively small stretches of St. Johns County are well drained. These occur in high hammocks and undulating to gently rolling areas in the northwestern corner of the county between Julington and Cunningham Creeks, also along St. Johns River and Trout Creek, and in the ridges and along the larger streams in the low-ridge region in the eastern part of the county. The remainder of the county, with the exception of scattered, small, low, ridgy areas of about 10 to 100 acres, is poorly drained.

There are large areas in the county in which drainage is altogether lacking or only partially established. Such places are conspicuously marked by many large swamps and "bays," which often lie at the higher elevations. The largest of these, Twelvemile Swamp, in the eastern part of the county, is about 12 miles long and one-half mile to 3 miles wide. Other large swamps and bays, ranging from 1 to 10 square miles in area, are the swamps at the junctions of Deep and Tocoi Creeks with St. Johns River, Big Cypress Swamp, and Shingle and Big Trestle Bays. There are many other smaller swamps and bays, and cypress ponds, containing from 1 to 25 acres, are very numerous throughout the flatwoods region of the county.

The present streams are very sluggish and have not developed valleys. It is often difficult to determine the extent of the overflow land, owing to the gradual merging of the bottoms into the upland. In many cases the water spreads out over wide areas. Only the larger creeks and rivers have well-defined channels. The streams generally head in swamps or bays and in their upper reaches are intermittent. Both creeks and branches are fringed with a heavy growth of cypress and hardwood.

This is one of the oldest settled sections of the United States. Ponce de Leon in 1513 landed at or near the present site of St. Augustine. In 1565 a Spanish settlement was begun at St. Augustine under the leadership of Pedra Menedez. The Spaniards remained in control until 1763, when possession of this region was ceded to the English. It is said that Dr. Turnbull, with other English associates, in 1767, formed a colony of Europeans, consisting of over 4,000 people, mainly from the island of Minorca, but to some extent from the Grecian Archipelago and the island of Corsica, and settled on lands between St. Augustine and New Smyrna in Volusia County. The descendants of these Minorcans form a considerable part of the present population of St. Augustine and of much of the

The general elevation of the basin country is about 700 to 900 feet above sea level, while that of the surrounding ridges or higher land varies from 1,000 to 1,200 feet. Plate I, figure 1, shows a typical view of the basin country.

The rocks of the Farmington Plain consist of rather pure limestone, sandstone, and shale. They are soft, or at least succumb much more easily to weathering than do the porphyries and the cherty limestones, with the result that the latter give rise to a more rolling surface. In general, wherever the limestone beds predominate the surface is undulating; where the sandstone occurs the relief is bolder.

The general drainage of the north half of St. Francois County is northerly in direction and into the Meramec River. The southern part of the county is drained by the St. Francis River and its tributaries.

The stream valleys are in general very irregular, have narrow flood plains, and in places contract to mere gorges. The slope of the stream beds varies from 5 to 30 feet per mile, the descent being greatest in the narrower valleys. A few springs are found in the county, but springs are not as numerous as in most of the Ozark region.

More than 50 per cent of the area of St. Francois County remains forested. Black oak, red oak, white oak, hickory, elm, and walnut are the principal upland trees. On account of frequent cutting, most of the timber is small and of little commercial value, but railroad ties are cut in large numbers.

St. Francois County includes the most productive lead-mining region in the world. Most of the mines are situated in the central part of the county, at Bonneterre, and in the territory adjacent to Flat River. In addition to lead, copper, zinc, nickel, and barytes are produced in considerable quantity. More than 80 per cent of the population of the county is engaged in mining activities. Granite is quarried in the southwestern part of the county.

This territory was first settled in 1794. The census reports a total population of 35,738 in 1910 and of 31,403 in 1920. Farmington, the county seat, had a population of 2,685 in 1920; Bonneterre, a population of 3,815; Elvins, 2,418. Bonneterre, Flat River, Desloge, Elvins, and Leadwood are mining towns situated in the so-called "lead belt." Bismarck, with 949 inhabitants, is the junction point of the Belmont Branch of the Missouri Pacific Railroad with the main line.

The transportation facilities are sufficient to serve the agricultural interests quite adequately. The Missouri Pacific Railroad, including the Belmont Branch, gives an outlet to the north and south. The Mississippi River & Bonne Terre Railway traverses the mining region and gives direct access to St. Louis. The Illinois Southern connects the county with the coal region of southern Illinois.

The public roads, on the whole, are kept in fair condition. More than 100 miles of road are macadamized. The numerous limestone outcrops and the crushed stone from the lead mines furnish excellent road material in unlimited quantity.

CLIMATE.

St. Francois County has a healthful, temperate climate, without prolonged hot or sultry weather in the summer or extreme cold in the winter. The difference in topography from place to place is not sufficient to cause any local dissimilarity in climate. The mean annual temperature is 54.5° F. There is an average growing season, or period without frost, of 185 days. The summer temperatures often reach 95° F., and occasionally exceed 100° F. In some winters the minimum temperatures scarcely reach zero, while in others they fall 10° or 15° below.

The average annual rainfall amounts to 46 inches, and the precipitation is well distributed throughout the year. It is heaviest in June and July. The snowfall is usually light, and snow seldom remains on the ground for more than a week at a time. Short periods of drought occur in the late summer and early fall.

The average date of the first killing frost in the fall is October 13 and that of the last in the spring April 11.

The following table, giving the more important climatic data, is compiled from the records of the Weather Bureau station at Ironton, Iron County, adjoining St. Francois County on the south and west.

Normal monthly, seasonal, and annual temperature and precipitation at Ironton, Iron County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	34.4	71	−16	2.98	4.36	3.24
January	32.3	72	−10	3.01	1.66	3.26
February	33.4	74	−18	3.47	2.42	1.49
Winter	33.4	74	−18	9.46	8.44	7.99
March	45.1	90	2	4.40	4.93	4.91
April	55.4	91	20	4.35	3.92	4.53
May	64.6	96	26	4.93	.47	4.55
Spring	55.0	96	2	13.71	9.32	14.29

Normal monthly, seasonal, and annual temperature and precipitation at Ironton, Iron County—Continued.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	F.	*Inches.*	*Inches.*	*Inches.*
June	72.0	100	36	5.08	2.36	3.51
July	75.6	113	47	4.57	2.42	14.74
August	74.3	105	43	3.43	1.41	7.62
Summer	74.0	113	36	13.08	6.19	25.87
September	67.7	104	29	3.49	1.26	8.62
October	55.9	96	20	2.67	1.18	5.03
November	44.0	83	8	3.71	2.32	1.87
Fall	56.0	104	8	9.87	4.76	15.52
Year	54.4	113	−18	46.12	28.71	63.67

AGRICULTURE.

The most important agricultural area of St. Francois County is the lowland basin, which includes all of the eastern part of the county and several minor areas in other parts where the red and more nearly level soils predominate. The hill land throughout the western and northern parts of the county is yet largely undeveloped, and the St. Francois Mountain region remains in an almost virgin condition. Not more than 35 per cent of the county is under cultivation and more than 50 per cent is still forested. In the number of people engaged and as a source of income agriculture ranks next to mining. In general the farming industry has not reached as high a degree of development as in many other parts of the State, partly as a result of the extensive mining operations.

General farming and stock raising make up the agriculture. Dairying and trucking are in the aggregate of considerable importance. On the whole the farm practices are commendable. Crops are rotated to a considerable extent, stable manure and fertilizers are in general use, the value of growing the legumes is appreciated, and thorough plowing and preparation of the seed bed are the rule. In general the agriculture in the lowland basin is similar to that of the eastern Ozark border region, while the agriculture of the hill lands corresponds to that of the rough central Ozark region to the west and south.

Agricultural development in this county has been slow and intermittent. The opening of the lead mines in 1825 turned interest away from the farms, and agriculture lapsed. During the Civil War most of the farms were abandoned, and, moreover, the increased mining activities at that time made farming unattractive. The rapid development of the mining industries, together with the prevailing low prices of farm products during the period from 1890 to 1910, was unfavorable to agricultural progress. Large tracts of land were bought up by mining companies and left unfarmed. During the last decade farming has started upon a new era of prosperity.

The system of farming is governed largely by the location and general character of the land. Throughout the hilly region in the western and northern part of the county the raising of live stock is of chief importance, as the limited area of arable land and the extensive range and pasture land makes this the most profitable industry. Even in the lowland basin bordering the hills considerable live stock is kept and pastured on the near-by hill land. In most of the basin country, however, except in those places where the soils classed in the Tilsit series are thin and best adapted to grass, grain farming receives first attention. It would seem that because of the large percentage of land best adapted to pasture the live-stock industry should be of chief importance, but the relatively small percentage of land well suited to the growing of corn has prevented this industry from reaching its maximum development. It is probable that a readjustment in the farm practices, which will result in an increased production of forage crops for winter feed and the keeping of more live stock, will permit the more complete and efficient utilization of the typical pasture lands.

Corn, wheat, oats, and hay are the principal crops grown. In 1909 a total of 20,111 acres were devoted to corn, which gave an average yield of 22.5 bushels per acre. This is about the annual average, both in acreage and yield. Corn is grown throughout the county and on all soils. Yields range from 15 bushels, or even less on certain of the poorer types of soil, to 60 or 70 bushels per acre on the Hagerstown and Decatur soils. Manure is commonly used on corn, and as far as possible the crop is planted on sod ground. Very little corn is sold from the farm.

Wheat, like corn, has been grown since the first settlements were made, and it still remains, over the greater part of the county, the principal money crop. The area devoted to wheat in 1909 amounted to 8,114 acres, and the average yield was 12.6 bushels per acre. Wheat is grown on all the different soil types of the county, as a matter of convenience in the present system of farming and irrespective of the adaptation of the soils. The yields range from 10 to 30 bushels per acre. The red limestone soils are naturally best adapted to wheat.

Commercial fertilizer is in general use and is essential for profitable yields on all but the best soils. A fertilizer containing 8 to 16 per cent or more of available phosphoric acid, applied at the rate of 125 to 200 pounds per acre, has been found to give the best results on wheat.

Oats are a relatively unimportant crop, occupying a total of only 3,273 acres in 1909. The yield in that year averaged only 20 bushels per acre. Oats are not a profitable grain crop, and are grown mainly as a nurse crop for clover. Preparation of the land, seed selection, and fertilization are given less attention than is the case with the other cereal crops.

Rye is grown in a small way on many farms. It affords good winter cover, in addition to pasturage, and should be grown more extensively on steep hillsides subject to serious erosion. As a green manure it is particularly valuable on the Tilsit soils, which are greatly in need of organic matter and do not grow clover successfully.

Cowpeas and soy beans are receiving increased attention as hay and forage crops. They are particularly well suited to the gray soils where clover does not make a good growth. The best practice for the poorer soils is to pasture these crops or turn them under as a green manure. Cowpeas may follow any small grain as a catch crop, and are valuable for succeeding wheat where the clover has been killed out. Planting soy beans with corn is good practice when the field is to be "hogged off."

Small patches of sorghum are grown for forage and for the manufacture of sirup. The crop produces a large amount of forage, and should receive more attention as a winter feed.

The hay grown is almost entirely mixed timothy and clover. Normally about 18,000 acres are devoted to this crop. On the poorer soils, such as the Tilsit, Lebanon and some of the Clarksville types, the hay lands deteriorate rapidly, and when 2 to 4 years old are usually foul with briers and weeds. In depressions and poorly drained areas the hay grasses consist largely of redtop. Clover is an important crop not alone for hay and seed, but as a soil improver. All the red limestone soils are good clover soils, and on most of the Clarksville types a good stand can usually be obtained with little difficulty. Such failures as do occur are mainly due to unfavorable weather. Where the difficulty is caused by soil conditions, the use of lime and barnyard manure will insure success. The older fields that have become depleted of organic matter are in greatest need of this crop, but generally are the most difficult on which to secure a stand.

Alfalfa has thus far been grown only in an experimental way, and with but fair success. The poor results have been due in most instances to the fact that the thinner and poorer lands have been

selected, in the hope of enriching them, but in some instances to failure to prepare the seed bed properly by liming and inoculating the soil. Alfalfa can without much doubt be successfully grown on the Hagerstown and Decatur soils where the deeper and better areas are selected. Sweet clover will thrive on all the red soils, and on others that are well supplied with lime.

The pasture grasses consist mostly of bluegrass, orchard grass, and white clover. Bluegrass is grown in all parts of the county, but does best on the limestone soils. Because of the slight attention given to pastures and the lack of fertilization, the sod is usually thin, and a relatively large acreage (2 to 4 acres) is required to maintain one cow or steer. Japan clover is the most important range plant. It is found in the virgin forest where there is little underbrush.

Trucking is carried on to a limited extent near some of the mining towns. In general, the soils of this region are not well suited to this industry, although the Hagerstown and Decatur soils, when heavily manured, give good yields of all the common vegetables, particularly tomatoes, cabbage, and potatoes. Only a small percentage of the local demand for vegetables is supplied by home-grown products, and it would seem that a large extension of the trucking industry would be profitable.

Orcharding in St. Francois County is not developed to any important extent, and not enough fruit is grown to supply the home demand. Most of the trees are of inferior varieties and poorly kept. The necessity of spraying to insure sound fruit is not yet appreciated. The red soils are well adapted to the production of apples, but the trees on the gray soils rarely make a vigorous growth. Peaches do well on the rolling Clarksville soils, but climatic conditions make the crop uncertain.

Some live stock is raised for sale on almost every farm, but the live-stock industry is not as important as in most other parts of the State. Only a relatively small area is well adapted to corn growing, so that the amount of grain and roughage available for fattening and wintering cattle is limited. Many farmers work in the mines during part of the year, and in such cases only keep enough live stock to supply farm and family. The extension of the live-stock industry seems to offer the most promising field for agricultural development.

Most of the cattle are marketed without fattening. In the hilly parts of the county cattle and hogs are allowed to range; in the farming regions much of the land is fenced and the stock is confined to pastures. Hog raising is not a special industry in any part of the county, but most farmers keep a small number to furnish the home meat supply and many have a surplus for sale. There are only a few flocks of sheep, although conditions are favorable to an extension of the sheep industry. Sheep require less grain than cattle and

should therefore fit well into the farming system on the hill lands. They would be effective also in keeping down the brush on newly cleared land.

Dairying is as yet a neglected industry, but conditions are favorable for its development. Good transportation facilities to St. Louis are available, there is a large local market, extensive pastures are to be had, and soiling crops are easily grown. Dairying not only can be made to yield a profit, but it is the most economical means of producing the stable manure which is so essential in the present system of farming for the production of large yields of the staple crops. It would not be profitable at the present time, however, to carry on an extensive dairying industry in those regions remote from railroads.

One outstanding fact regarding this territory is its great diversity of soil conditions. It is difficult to find a farm made up of a single soil type. On one part of a field the soil may be shallow and in another part deep; a patch here and there may be stony, while another part has bad drainage. It is difficult to find farms on which the land is all generally level or all slightly rolling. This makes it difficult for farmers to establish systematic crop rotations. Irregular areas must be kept in grass an indefinite time to prevent erosion or to build up the soil. In other words, the planning of the fields must be accommodated to the "lay" of the land, soil conditions, and the state of fertility of particular plots of ground. Each farm, therefore, has its peculiar problem in this respect. Most of the farmers in the better sections attempt to grow a cultivated crop like corn for one or two years; then a small grain, usually wheat, for one year, followed by hay and pasture for one or more years. The grass crops are the main reliance for building up soil productiveness. Red clover, through its power to take free nitrogen from the air and deposit it in the soil, replaces much of this important plant food taken out by other crops. The mass of grass roots which develop in the soil and the clover, grasses, and weeds not eaten by animals furnish organic matter which, when rotted down, supply humus. In addition, some benefit is derived from the manure of animals pasturing on the fields.

All the soils of the county respond to the use of commercial fertilizers, especially to phosphates. All the soils are fairly well supplied with potash. When attempting to build up a soil, however, it is often advisable to use fertilizers carrying a small percentage of potassium. All the soils are benefited more or less by lime, but the red soils are least in need of this element.

While lime benefits nearly all the crops commonly grown in this section, its most beneficial effects are shown by a better stand and a more vigorous growth of clover. The Tilsit soils and the smoother areas of the Lebanon soils show the highest lime requirement.

Applications of 1 to 2 tons of ground limestone per acre every four to six years probably would give good results.[1] The numerous beds and outcrops of limestone found in many parts of the county are well suited for crushing or burning.

The use of commercial fertilizers is steadily increasing, although very little as yet is used on corn. Generally, a fertilizer analyzing around 2–8–2 is applied to wheat land at the rate of 100 to 300 pounds per acre. Small amounts of bone meal also are used for grains. To insure a stand of clover or grass following wheat, the use of phosphatic fertilizers, such as acid phosphate, bone meal, or a mixed fertilizer high in phosphate, is especially desirable. The foremost need of all the soils in the county is a plentiful supply of vegetable matter. Commercial phosphates, as well as lime, are most effective only in soils plentifully supplied with organic matter. Stable manure is the best material that can be used to maintain soil fertility, since it supplies not only nitrogen, phosphorus, and potash but organic matter as well. However, manure alone will not maintain productiveness at its possible maximum, and the applications should be supplemented with phosphatic fertilizers. If the fields were properly fertilized and handled, the present crops might be grown on three-fourths the area now cultivated at a smaller expenditure of time, labor, and money. It would be more profitable to abandon the least productive fourth of each farm and to use it for pasture, concentrating upon the remaining three-fourths the labor and energy that is now spent in going over land that can not by any possibility produce full yields. The present average yield of corn, approximately 24 bushels per acre, if increased by 6 bushels, would permit a reduction in the total acreage of almost 20 per cent without a reduction in the total production of the county. The necessity of increased yields and of improvements in the present methods are appreciated by the more intelligent farmers. Crop yields and farm incomes must keep pace with increasing land values and the increasing cost of farm machinery, work animals, labor, and the necessities of life. The first step is to increase the productiveness of the soils.

The total area of the county is 293,120 acres. In 1910, according to the census, 182,970 acres, or 62.4 per cent of the land area, was in farms, and of this area 96,862 acres, or 52.9 per cent, was improved. The number of farms in the county is reported as 1,243, of an average size of 147.2 acres per farm. About 70 per cent of the farms are operated by owners. As a rule the larger farms are found on the better general farming soils in the eastern part of the county.

[1] Bulletin No. 171, "Agricultural Lime," by the Mo. Agr. Expt. Sta., gives information on the use of lime.

Small tracts of wooded land, most of them poorly suited for agricultural purposes, are being cleared annually.

Land values show considerable range, depending upon the improvements, the location, the productiveness of the soil, and, in some sections, the mineral value of the land. The present (1918) prices of the better farming land range from $40 to $125 an acre. Much of the hilly land of little agricultural value is held at $10 to $20 an acre. Most of the known mineral-bearing land is now owned by large mining companies.

There can be a small extension of the agricultural domain in this county, mostly on the moderately rolling hill land in the western and northern parts. There can be a great extension of the pasture lands, which will permit a much greater development of the livestock industry. Most of the nonarable hill land, representing about 40 per cent of the area of the county, is fairly well suited to pasture. Its better utilization is dependent mainly on the removal of the timber and the control of the undergrowth.

SOILS.

The varied character of the soils of St. Francois County is the result of diversification of the rocks from which they are derived and of the differences in weathering and erosion they have undergone during their formation. All the upland soils are residual; that is, they are in their place of origin or have not been moved appreciable distances, and inherit their characteristics mainly from the rock which immediately underlies them. The action of weathering has, however, nearly everywhere modified the original characteristics, tending to make the soils more nearly uniform in such characteristics as color, texture, and structure. It is for this reason that the various soil types do not necessarily coincide with the parent rock, but may extend over several geologic formations.

Geologically the soils are some of the oldest in the State. The country rocks have been disintegrated and decomposed to depths varying from 10 to 60 feet, and only on steep slopes, where erosion is active, is the bedrock exposed. The freshness or stage of decomposition of the mineral particles has a profound effect on the chemical and physical properties of the soil. Long-continued weathering of the soil material has resulted in the removal of the more soluble parts, while the less soluble have remained. It is for this reason that all the soils show a deficiency in lime—a deficiency which is least in the youngest, or red soils. Leaching has further caused the development of unfavorable conditions in the subsoil in places where the surface is level or nearly so. The filtration downward and the concentration of clay in the subsoil, accompanied by compaction, has

made the substratum somewhat impervious to water, and retarded complete oxidation of the soil material. The low content of lime in the soil, together with the forest cover, was unfavorable to the accumulation of large quantities of organic matter, so that none of the soils are dark in color, but are generally some shade of gray or brown.

In the system of classification used the soils are separated into series and types, primarily on the basis of color, origin, and character of the soil material. Each series includes soils similar in these fundamental features. The soil type, the unit of soil mapping, is separated solely on the basis of texture, or the relative proportions of the materials of different grades, as sand, silt, clay, of which it is composed. On this basis of mapping, 10 soil series with 15 soil types are recognized in this county. The soil series bears a close relation to the broader geologic divisions, while the soil type bears a close relation to lithologic phases and to minor topographic forms.

The southwestern part of the county is principally underlain by igneous rocks, mostly granite, porphyry, and rhyolite, of Archæan age. With long weathering these rocks have been largely reduced to clay to a great depth. The resulting soils are classed in the Ashe series. This series is characterized by gray or grayish-yellow surface soils and by the yellowish-brown color and moderately friable structure of the subsoil, which is usually a clay.

The first deposit on the igneous rocks was the La Motte sandstone, of Cambrian age, consisting mostly of fine-grained sand, and including near the top limestone beds. This formation as a source of soil material occurs mainly in the eastern and southeastern parts of the county and gives rise to the Tilsit series. The soils of this series range from gray to pale yellow and have brownish-yellow subsoils, mottled in the lower portion.

The Bonneterre limestone, a dark-gray and light-gray dolomite, and the Elvins formation, consisting of shale and limestone, are the next members of the ascending series. On account of their relative thinness they are not important soil formers. The next highest formation is the Potosi, which consists mainly of thick-bedded, siliceous dolomite alternating with beds of chert. The formation is about 300 feet thick and is of rather wide distribution around the edge of the Ozarkian formations. The weathering of the Potosi gives rise to the red and brown colored soils which have been classed in the Decatur and Hagerstown series. Some of the other limestones occurring in this region give rise in some places and under certain conditions to red and brown soils, but in the main the latter are derived from the thicker bedded and purer limestones.

The types included in the Hagerstown series have brownish or yellowish-brown surface soils, and yellowish, in places yellowish-red,

clay subsoils. The Decatur soils differ from the Hagerstown chiefly in color, having a reddish-brown surface soil and an intense-red subsoil. In the process of weathering solution has been dominant rather than decomposition and disintegration; that is, the inorganic constituents of the soil represent mainly the impurities of the original limestone, the calcium and magnesium carbonates having been removed in solution. In such a process of weathering there is a distinct plane of separation between the soil mass and the underlying rock. The rock floor has a billowy or uneven surface due to inequality of solution, and the thickness of the soil layer varies accordingly. The limestones, being less resistant to weathering than the surrounding harder rocks, have been worn away to a greater extent and generally occupy valley-like basins. The difference in the color of the soil is mainly due to the lithologic character of the limestone and to the age of the soil material. Rocks most free from carbonaceous impurities and those that have undergone the least weathering give rise to the red soils. Generally the soils derived from the more calcareous limestones are more productive than those derived from the argillaceous and siliceous limestones, where existing under practically the same conditions of drainage and topography.

The gray limestone soils have been included in the Clarksville and Lebanon series. Both series are typical Ozark soils and have a wide distribution in the central Ozark region. The Clarksville soils differ from the Lebanon chiefly in having a more rolling surface, a more yellowish subsoil, and less gray mottling and less compaction in the lower subsoil. The surface soils are gray, often with a slight brownish shade at the immediate surface, especially where vegetable matter has been worked into the soil. Drainage is better established than on the Lebanon series. On the level ridges the Clarksville often grades into the Lebanon, and as mapped in this county some of the Clarksville silt loam includes patches of Lebanon silt loam. The rocks from which the Clarksville soils are derived vary from pure dolomite to very cherty dolomite. The latter, represented mainly by the Gasconade formation, is made up of beds of cherty dolomite, chert, and sandstone. The cherty and more argillaceous limestones superimpose and generally are more resistant to weathering than the adjacent purer beds, and have formed the conspicuous topographic features, such as the western and northern hill region.

The Lebanon series is characterized by gray or pale-yellow surface soils and yellow subsoils, with gray mottling and often a compaction in the lower subsoil. The material is derived mainly from chert-free limestone. The latter has weathered rather uniformly, so that the surface is level or undulating except in places where erosion has been active. On account of the level surface the soil has reached a

more advanced stage of weathering than the younger red soils or the rolling Clarksville types. Much of the more soluble plant food has been leached away and unfavorable subsoil conditions have developed.

The alluvial soils of the county are largely of local derivation. All the streams, except Big River, originate in the county or in near-by counties which are similar geologically and have similar soils. The soils of the Huntington series are brown. The Robertsville soils represent old alluvium, occupying second bottoms. They are gray in the surface and mottled gray or bluish gray and yellowish in the subsoil, which is often compact or plastic and impervious.

In general, the soils of St. Francois County contain less stones and are of higher agricultural value than the soils of the main Ozark region to the south and west. They resemble more nearly in physical properties and agricultural importance the extensive area of limestone soils in the counties to the east, bordering the Mississippi River from St. Louis to Cape Girardeau.

The table below gives the name and the actual and relative extent of each of the soils mapped in St. Francois County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Clarksville silt loam	54,144	20.4	Huntington fine sandy loam	4,544	1.5
Glade phase	5,504		Huntington gravelly loam	3,904	1.3
Lebanon silt loam	52,544	17.9	Robertsville silt loam	2,816	1.0
Hagerstown silt loam	38,336	13.1	Colbert silt loam	1,600	.5
Clarksville gravelly loam	36,800	12.6	Guthrie silt loam	832	.3
Ashe stony loam	27,584	9.4	Tilsit fine sandy loam	768	.3
Ashe silt loam	24,832	8.5	Mine dumps and clay pits	384	.1
Tilsit silt loam	21,440	7.3			
Huntington silt loam	10,688	3.6	Total	293,120	
Decatur silt loam	6,400	2.2			

HAGERSTOWN SILT LOAM.

The Hagerstown silt loam is a brown, mellow silt loam, underlain at 8 to 12 inches by yellow or reddish-yellow, moderately friable silty clay loam. The latter between 15 and 20 inches passes into reddish-brown or dull-red crumbly clay, which is rather compact in the lower part. In places black and brown concretions are found in the lower subsoil. Where the type passes into the Lebanon silt loam, with which it is closely associated, the surface soil is usually grayish brown in color, and the subsoil may contain gray and brown mottlings. Generally the color becomes redder with increase in depth, but on some of the level areas, where drainage is not well established,

the subsoil is often yellow or only slightly reddish yellow to a depth of 3 feet or more. On slopes where erosion has been more active the silty loam surface soil is very shallow or has been entirely washed away, giving rise to small areas of clay loam. In cultivated fields these eroded spots are prominent by reason of their reddish color. These areas could not be shown on the map on account of their small size and irregularity of occurrence.

The soil is generally free from stones, although outcrops of the limestone parent rock are found, usually along the steep slopes near streams. The soil mantle over the bedrock varies from 5 to 30 feet in thickness.

The Hagerstown silt loam is the most important as well as one of the most extensive soil types mapped. The largest areas occur in the lowland basin, in the eastern part of the county. The surface varies from gently rolling to almost level, and is everywhere well suited to cultivation. Plate I, figure 1, shows the characteristic topography of this soil. Drainage is adequate, and the soil is retentive of moisture. This land was originally forested with various kinds of oak, elm, walnut, gum, and hickory.

The Hagerstown silt loam is used almost entirely for general farming. It is considered one of the strongest and most productive upland soils in the county, and the farm improvements indicate that it is the most valuable type. The principal crops are corn, wheat, clover, and grasses. Corn yields 30 to 65 bushels per acre, averaging 40 bushels, and wheat 15 to 30 bushels, with an average of about 20 bushels. From 1 to 2 tons of hay per acre is produced. Alfalfa where established yields from one-half ton to 1 ton per acre at a cutting and gives four cuttings a season. This is a natural clover soil and the crop grows luxuriantly except where the soil has been allowed to decline in productiveness.

This is the oldest cultivated soil in the county. Continuous cropping, mostly to corn and wheat, has reduced its content of organic matter until the soil has deteriorated in physical condition and is more difficult to work. The increasing difficulty of growing such crops as clover is further evidence of this condition. The remedy is to increase the organic content by plowing under every available form of vegetable matter, such as farm manure, corn stalks, straw, clover, and even weeds. The organic matter, important in improving the physical condition of the soil, is of even greater importance in adding addition of nitrogen.

Another need of this soil is phosphorus. The use of phosphatic fertilizers gives good returns, particularly on the small grains. The soil is fairly well supplied with potash, and with good farm practices there will remain available enough of this element for average yields. In places where it is difficult to get a stand of clover,

ground limestone should be applied at the rate of 1 or 2 tons per acre. Most of the lime has been washed out of the surface soil, but the subsoil as a rule is fairly well supplied with this element.

Ordinary farming land of this type is valued at $60 to $125 an acre, but higher prices have been obtained for small tracts near the towns. Favorable location is responsible for the very high prices occasionally obtained, rather than superior productiveness.

DECATUR SILT LOAM.

The Decatur silt loam, like the Hagerstown, is locally known as "red limestone land." In the field it differs from the Hagerstown chiefly in having a true red color. The surface soil is a dark-red to reddish-brown, mellow silt loam, underlain at 6 to 10 inches by a deep-red, friable silty clay loam to clay which passes at 18 to 24 inches into deep-red clay of a brittle structure. When dry the subsoil is quite compact. Several included areas, too small to map, have been eroded in such a way as to expose the red subsoil material. These represent patches of Decatur clay loam. The thickness of the soil mantle is not so great as in the Hagerstown silt loam, and in many places does not exceed 3 to 6 feet. Rock outcrops in the form of ledges are numerous, particularly on the steeper slopes, and sometimes limit the size of the fields.

This type occurs in the central part of the county, in close association with the Hagerstown, from which it is frequently distinguished with difficulty. The largest areas occur at Farmington, east of Desloge, and northeast of Bonneterre. The surface is uniformly undulating to very gently rolling, and as a whole the type is well drained.

The Decatur silt loam appears to be derived from a stratum in the Potosi limestone differing from that giving rise to the Hagerstown silt loam, possibly being a purer or more ferruginous limestone. The fact that it occupies similar topography to that of the Hagerstown would seem to controvert the theory that its red color is due to more complete oxidation resulting from better drainage. The soil is inherently more productive than the lighter-colored limestone types and is better supplied with lime than any other of the upland types.

The same crops are grown and the agricultural practices are about the same as on the Hagerstown silt loam, and under the present system of farming the type has about the same agricultural value. In other counties this soil has proved to be an excellent one for orcharding and truck farming. With constant cropping the supply of organic matter has been reduced, but this can easily be restored by growing clover, to which crop the soil is especially well adapted. The supply of lime seems to be sufficient for present needs, but manuring would be beneficial.

Land values average about the same as in the case of the Hagerstown silt loam, but in many places are higher, primarily on account of the more favorable location near towns.

CLARKSVILLE GRAVELLY LOAM.

The profile of the Clarksville gravelly loam is much like that of the Clarksville silt loam, except that the depth to the yellow silty clay loam or silty clay subsoil and to the red substratum is less. The surface soil is a gray, gravelly silt loam, which passes at 2 or 3 inches into pale-yellow gravelly silt loam, and this into yellow to brownish-yellow, very gravelly silty clay. The content of gravel increases with depth until it becomes impossible to bore into the material with the soil auger. In general, that part of the type in the northwestern section of the county has more uniformly a brownish subsoil, which characteristic is generally associated with greater productiveness. On south slopes the soil is generally more gravelly than on north slopes. Some of the chert fragments are large, but in the bulk of the material the gravel fragments are less than 5 inches in diameter. As a whole, the type in the northeastern part of the county contains the least gravel.

The Clarksville gravelly loam occupies steep slopes and sharp ridges in the roughest and most completely dissected parts of the county. It is closely associated with the Clarksville silt loam, but is much more steeply rolling. Practically all the type is nonarable, on account of the steepness of slope and the high content of gravel. Cultivation usually results in severe erosion. Many of the moderately rolling areas could be converted into good pasture lands after the forest is removed, but all the very broken areas should remain in forest or woods pasture.

There are included areas, shown by stone symbols, in which the chert fragments average larger than over the rest of the type. The slopes here are, as a rule, steep. These stony areas occur mainly in the extreme northern part of the county, but a few small areas lie in the southeastern part. All these very stony areas are in forest. Some of them are used for range pasture, and forestry and grazing are the best uses to which they can be put.

CLARKSVILLE SILT LOAM.

The Clarksville silt loam resembles the Lebanon silt loam in most respects, but differs in including a larger proportional area with less mottling in the subsoil, in having a more rolling surface, a shallower depth of soil overlying the red material, and in containing a greater abundance of chert fragments on the surface and throughout the soil section. The last characteristic is probably due in part to the deriva-

tion of this soil from a more cherty limestone than that giving rise to the Lebanon, and in part to the accumulation of chert through continued removal of the fine soil material by erosion.

The typical Clarksville silt loam consists of a pale-yellow to yellowish-gray silt loam underlain at 6 to 8 inches by yellow, friable silty clay loam or heavy silt loam which grades at 15 to 18 inches into yellow silty clay. The lower subsoil of many areas below 24 inches is a somewhat compact silty clay more or less mottled yellow and gray. These areas are chiefly found on the smoother slopes or tops of the ridges. Some of them really represent included areas of Lebanon silt loam. On the slopes there is more yellow in the subsoil and in places a reddish cast or reddish-yellow color is distinguishable, showing better subsoil oxidation than on the Lebanon silt loam. Angular chert fragments are found on the surface and are moderately abundant in the subsoil, being nearest the surface on the slopes. There are included small patches of Clarksville gravelly loam.

The Clarksville silt loam occurs throughout the hilly and dissected parts of the county, but is most extensive in the northern part. It occupies narrow ridges and steep slopes, and in most places is too rolling to permit of cultivation. In the northern part of the county most of the type is found on ridges, flanked on the slopes with gravelly or stony loam. These areas are usually not too broken for cultivation, but the soil is less productive than on the slopes.

The Clarksville silt loam is primarily best suited for grazing. Only the lower slopes and some of the broader ridges are suited to cultivation. About 10 per cent of the soil is used for crops, but the area can be enlarged considerably. The tree growth consists mainly of various kinds of oak, hickory, and elm.

Corn and grass are the principal crops, the yields comparing favorably with those obtained on the Lebanon silt loam. The soil is best suited to grasses. When the land is cleared a mixture of grasses, usually bluegrass, orchard grass, redtop, and white clover, gives good results. Some of the trees are allowed to stand, in order to check erosion. On newly cleared land it is necessary to keep sprouts down for two or three years, which is done either by hand or by the use of goats. It is probable that peaches, some of the small fruits, and such crops as tomatoes would be successful on some of the lower slopes and moderately rolling areas.

The first need in the management of this soil is the prevention of surface washing and gullying. In growing crops a rotation should be practiced that will keep the soil in grasses, as much of the time as possible. The land should be plowed deeply, and contours should be followed as nearly as possible in plowing, planting, and cultivating. Every means should be employed to increase the organic content. This will keep the soil in good condition so that

it will absorb a large amount of water, and thus diminish the run-off.

This soil can be improved in the same way as the Lebanon silt loam. probably the best legumes to grow are red clover and alsike clover, but in order to get a stand it will probably be necessary to use burnt lime or ground limestone. Land values on the typical Clarksville silt loam range from $15 to $75 an acre.

Clarksville silt loam, glade phase.—The glade phase of the Clarksville silt loam includes areas marked by frequent rock outcrops and in which bedrock occurs so near the surface that the land can not be cultivated. The soil material is essentially like the main type, but averages slightly darker in color, and the subsoil is a clay loam in texture.

The largest areas of this phase occur along Big River in the west-central part of the county, occupying eroded slopes bordering short branches. Practically all of the phase is in forest. Red cedar is the characteristic tree growth, and is of considerable commercial value. Where the forest growth is not too dense, wild grasses make a good growth. The phase can best be used for forestry.

LEBANON SILT LOAM.

The soil of the Lebanon silt loam is a yellowish-gray to brownish-gray silt loam, varying from brownish, as it grades into the Hagerstown silt loam to light gray on the level and more poorly drained areas. Usually the surficial 2 or 3 inches in the forested areas is gray and of floury structure. The subsurface layer below a depth of 5 or 6 inches is usually a grayish-yellow to brownish-yellow silt loam. At an average depth of 8 or 10 inches yellow, rather friable, silty clay loam is reached, and this passes at depths of 12 to 20 inches into yellow silty clay, usually compact and mottled with gray and brownish colors in the lower part of the 3-foot section. Slight variations in the subsoil are of rather common occurrence. On the level areas, where the surface soil is gray, the subsoil contains black and brown concretions and concretionary material and is rather impervious. In the better drained situations the lower subsoil is tinged with red, having a light-buff or yellowish-red color. The typical red substratum, which is generally reached between 40 and 60 inches, resembles the Hagerstown subsoil. When dry the lower subsoil is very compact. The type is characteristically free from chert fragments within the 3-foot section.

The topography varies from nearly level to undulating and gently rolling. Surface drainage in the main is good, but some of the more nearly level areas and shallow depressions could be improved by tiling. The characteristic flat topography is well shown in Pl. I, fig. 2. On some of the more gently rolling areas the surface soil

has been partly removed by erosion and the subsoil material is near enough to the surface to be turned up by ordinary plowing, so that newly plowed fields have a spotted yellow and gray appearance. In general, the Lebanon silt loam occupies a slightly higher position than the Hagerstown and Decatur soils, with which it is closely associated, but it is not quite as rolling. Drainage is effected mainly through shallow swales which contain running water only during wet seasons.

This type is widely distributed throughout the eastern and central parts of the country. It is derived from limestone of several formations. Some of the beds are argillaceous, while some are pure dolomites, and none have a high content of chert.

The original forest growth consisted of white oak, red oak, black oak, hickory, dogwood, walnut, and persimmon. Probably 75 per cent of the type is now cleared and in cultivation. The yields of corn and small grain are low or only fair, and on the whole are considerably less than those obtained on the red limestone soils. Corn yields an average of 20 to 35 bushels and wheat 10 to 18 bushels per acre. Clover grows fairly well on most of the type, but on some of the poorly drained areas and in places where the soil has run down special treatment is necessary in order to get a stand. The greater part of the type is used for pasture and mowing land. Sassafras and persimmon sprouts quickly spread over areas not cultivated, and hay lands when two or three years old generally become foul with weeds and briers. The commonly used rotation consists of corn one to three years, followed by wheat, then clover and grass, the latter being used for mowing and pasturage for two to four years.

Naturally this soil is of rather low productiveness, but, owing to its favorable position and the ease with which it can be cultivated, it is one of the most desirable farming soils of the county. It can be improved to the point of producing fairly good yields by applying stable manure and plowing under all crop refuse. A legume should be included in every rotation, and the growing of winter cover crops is recommended. The soil is usually acid in reaction, and lime should be applied to neutralize this acidity. One or two tons of ground limestone per acre applied once every six to eight years should be sufficient. The greater part of the type responds to applications of phosphoric acid, and this element must be supplied in fertilizers in order to obtain maximum yields. An average application of 150 to 300 pounds of bone meal or other phosphatic fertilizer gives especially good results on wheat, and helps to insure a stand of clover when the latter is to follow the grain crop. Many of the poorly drained areas of this soil, such as low swales and seepy slopes, could be

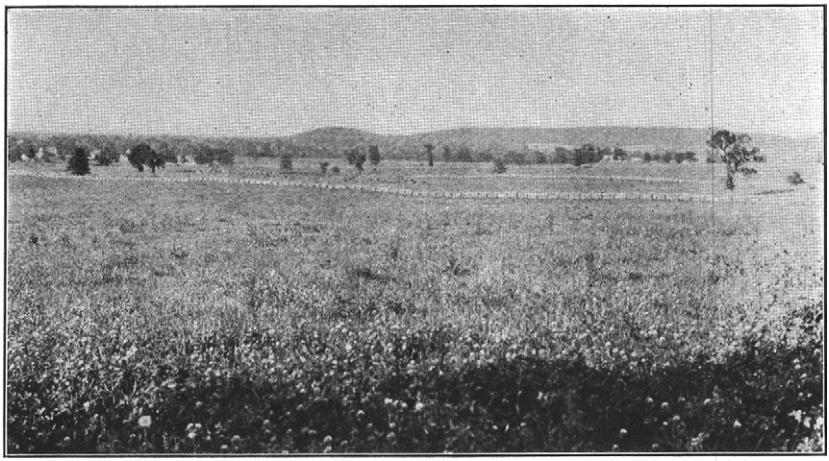

FIG. 1.—VIEW ACROSS BASIN COUNTRY.

The soil shown is the Hagerstown silt loam, whose characteristic gently undulating topography is well brought out. The excellent growth of clover testifies to the natural adaptation of the soil to this valuable legume.

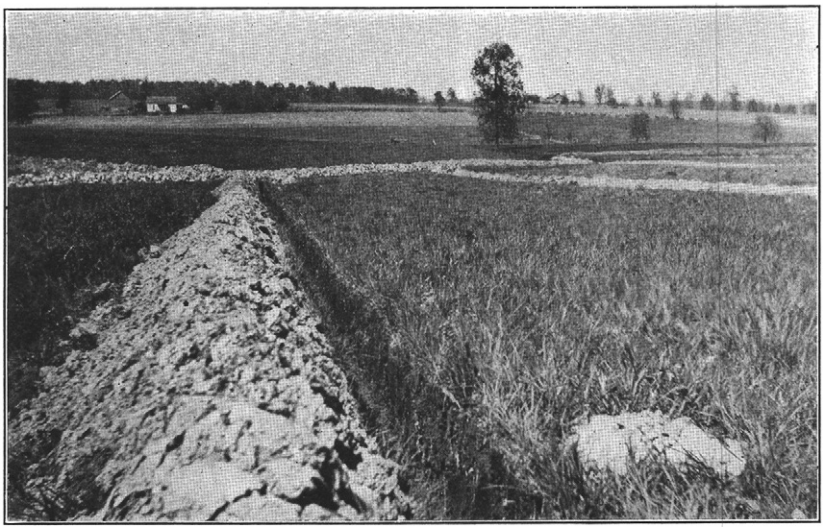

FIG. 2.—CHARACTERISTIC TOPOGRAPHY OF THE LEBANON SILT LOAM.

Level areas and seepage spots on this soil can be improved by tile drainage.

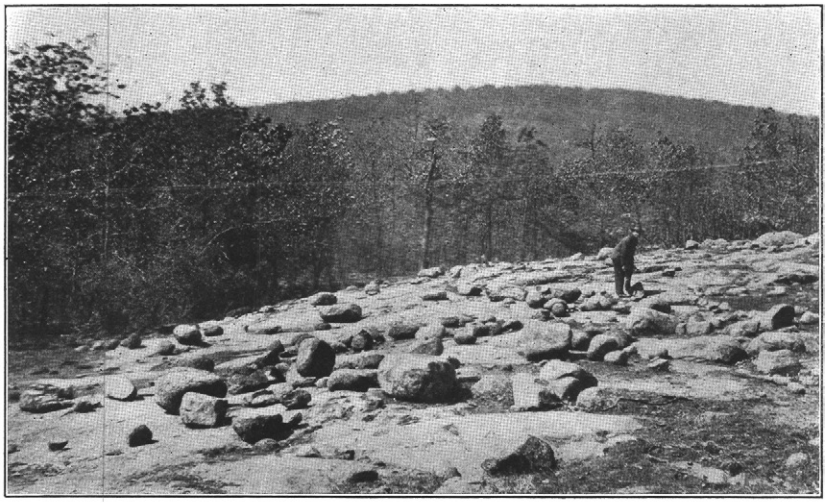

FIG. 1.—A GLADE IN THE ASHE STONY LOAM.

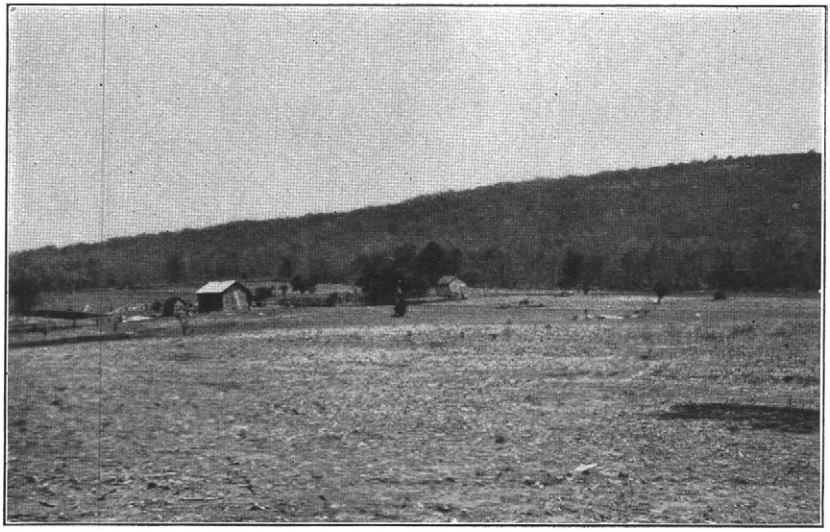

FIG. 2.—LEVEL VARIATION OF ASHE SILT LOAM. ASHE STONY LOAM IN BACKGROUND.

greatly improved by tiling. The tiles should be placed above the seepy area, so as to catch the water before it comes to the surface.

The selling price of this type varies from $25 to $100 an acre.

TILSIT FINE SANDY LOAM.

The Tilsit fine sandy loam differs from the Tilsit silt loam mainly in the higher content of sand and sandstone fragments. The surface soil is a gray to brown fine sandy loam underlain at 6 to 10 inches by reddish-yellow, friable silty clay loam which grades into a highly mottled, yellow and gray, crumbly clay loam. Small sandstone fragments are scattered throughout the soil section and over the surface. The unweathered or partly disintegrated sandstone bedrock is encountered in many places within the 3-foot section.

The Tilsit fine sandy loam is of small extent. It occurs on some of the steeper slopes within the larger areas of Tilsit silt loam. The soil is droughty and of low agricultural value. It is used mainly for pasture or remains timbered.

TILSIT SILT LOAM.

The typical Tilsit silt loam is a yellowish-brown to grayish-yellow silt loam which passes at an average depth of 8 to 10 inches into yellow silty clay loam, and this in turn at 15 to 18 inches into yellow, friable silty clay. The lower subsoil is a compact, yellow clay loam mottled with gray or bluish gray and yellowish brown. In many places the lower subsoil is noticeably sandy, and where the sandstone comes near the surface, as it does on some slopes, the soil is a loam in texture instead of a silt loam. On eroded slopes the subsoil is exposed, giving newly plowed fields a spotted yellow and gray appearance.

The sandstone from which this soil is chiefly derived is fine grained and disintegrates readily when exposed to weathering. It is for this reason that the bedrock is rarely exposed and the soil mantle is of great depth. More or less of the soil material is undoubtedly derived from limestone, and in many places the type resembles the Lebanon silt loam, with which it is closely associated. In general, the lower subsoil of the Tilsit silt loam is more highly mottled and more compact and impervious than the corresponding layer of the Lebanon silt loam. In many places it has the characteristics of a "hardpan" and is responsible in part for the low productiveness of the soil.

The Tilsit silt loam occurs in three main areas—the largest east and northwest of Knob Lick, the second east of Farmington, and the smallest south of French Village. The surface is gently rolling, and perhaps a little more rolling than that of the Lebanon silt loam,

but the slopes are characteristically long and gentle and well suited to cultivation.

The forest growth is rather scrubby and consists mainly of post oak, black oak, and blackjack oak. Probably less than 75 per cent of the type is in cultivation. Abandoned fields are quickly covered with sassafras and persimmon sprouts and briers. The type produces only fair yields, and most of it is used for mowing land and pasture. Clover does not do well. In the management of this soil one of the foremost needs is an increase in the content of organic matter. Another essential is that the acidity of the soil be neutralized by the application of lime in some form, so that clover and other legumes may be grown more successfully. An acreage application of 1½ to 4 tons of ground limestone should be made every six to eight years. The soil responds to phosphatic fertilizers, which can best be added in connection with farm manure or crop refuse. In every rotation the cultivated crops, such as corn or wheat, should be grown sparingly. The growing of winter cover crops is recommended, especially where there is danger of erosion. Rye is well suited for this purpose. The best legume to grow in the early steps in building up the soil is cowpeas. The type responds readily to proper cultivation and fertilization and can be made to produce profitable yields.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Tilsit silt loam:

Mechanical analyses of Tilsit silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
344109	Soil	0.7	3.9	3.0	8.7	6.6	59.6	17.5
344110	Subsoil	1.5	5.5	3.5	11.2	7.4	20.1	50.8

ASHE STONY LOAM.

The Ashe stony loam includes the mountain land in the southwestern part of the county. The soil to a depth of 5 to 8 inches consists of a pale-yellow to grayish-brown silt loam. The subsoil is a yellow or yellowish-brown, moderately friable silty clay which becomes lighter in color and heavier in texture with increase in depth. The lower part of the 3-foot section is ordinarily mottled yellow and rather crumbly. In many places the subsoil stratum is entirely wanting, there being only a thin mantle of soil resting on the solid bedrock, and it is not infrequently the case that the entire soil covering has been removed from the rock. This latter condition is shown in the illustration, Pl. II, fig. 1. Angular and rounded rock fragments are scattered over the surface and disseminated throughout the soil

and subsoil in quantity sufficient to give the land a decidedly stony character.

The type occupies steep mountain slopes, the largest body including Simms and Sulphur Mountains. On the larger mountains or hills, which are flat-topped, the soil is the Ashe silt loam, but such areas can not be separated on the map on account of being almost inaccessible. The soil material is derived from granite. Erosion has kept closer pace with rock weathering than in the case of the Ashe silt loam, and consequently the average depth to the rock is considerably less.

The Ashe stony loam is not farmed. It is best suited to forestry and pasturage. The forest growth consists principally of white and black oak. Where the soil is shallow the trees are scrubby. The destruction each year of the leaf mold by ground fires keeps the surface bare and results in severe erosion on account of the rapid run-off of the rain water. Much of the type essentially consists of Rough stony land, but the Ashe stony loam does not average quite as stony and rough as the areas ordinarily classed under the name of Rough stony land.

ASHE SILT LOAM.

The soil of the Ashe silt loam is a yellowish-brown to gray silt loam to a depth of 2 to 3 inches, changing to yellow or grayish-brown silt loam which passes at 6 to 10 inches into yellow silty clay. The subsoil below 18 inches is a yellowish-gray or brownish-gray, stiff, heavy clay, highly mottled and friable in the lower part of the 3-foot section.

Where the type occurs on nearly level areas or in flat-bottomed valleys of poor drainage, the soil is a light-gray silt loam grading into yellowish-gray heavy silt loam, which changes at about 16 to 18 inches to gray or drab, heavy, plastic clay somewhat like that of the Colbert silt loam. Locally such areas are known as "post-oak land," on account of the characteristic timber growth. Both run-off and underdrainage are deficient. This gray variation is of very low productiveness, and the soil very acid. The cultivated areas are used only for mowing land or pasture. Tame grasses after two or three years are generally crowded out by wild growths flourishing under acid soil conditions.

Small particles of quartz and granite are disseminated through the soil material, but are most abundant at the surface. Large fragments of granite are scattered over many areas, but these are not so plentiful as to interfere seriously with cultivation. The soil is derived chiefly from granite, but its close resemblance to the Clarksville silt loam, as well as the Tilsit silt loam, suggests that some of the surficial material may be from limestone which has disappeared, leaving only its residuum.

The Ashe silt loam occurs within the mountainous region in the southwestern part of the county. Plate II, figure 2, shows its position and topography. It occupies the broad, irregular, valleylike areas between the high peaks occupied by Rough stony land or the Ashe stony loam, and lies from 100 to 500 feet lower than the latter types.

The Ashe silt loam has a level to gently sloping surface, and is topographically well suited to farming, but only a little of it is cleared and in cultivation. Part of the type is not desirable for agriculture on account of its irregular distribution or stoniness. In value the type ranks slightly lower than the Lebanon silt loam. Pasturing would probably be a more profitable use of this soil than general farming. It seems to be well supplied with potash, but is very deficient in all the other plant-food elements, including lime. It is the oldest soil in the area and is the most thoroughly leached. Profitable yields can rarely be obtained without the use of manure. Better drainage is necessary for best results with this soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Ashe silt loam:

Mechanical analyses of Ashe silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
344113	Soil	3.1	4.2	1.4	3.6	5.3	68.5	13.9
344114	Subsoil	4.2	5.4	1.6	3.6	5.6	78.0	1.8

GUTHRIE SILT LOAM.

Throughout the uplands, in the areas of Lebanon soils, there are many poorly drained depressions, the soil in which is mapped as the Guthrie silt loam. The excess of water in these depressions, through the exclusion of air from the soil, has prevented complete oxidation, resulting in the light-gray color of the soil material and the mottled gray and yellow color of the subsoil. The soil, where typically developed, consists of a gray silt loam, grading at 6 to 8 inches into light gray, floury silt loam, mottled faintly in places with rusty brown, and passing at 18 to 20 inches into plastic, impervious, mottled yellow and gray clay. In some places the lower subsoil contains many black concretions. The material is the same in source as that giving rise to the Lebanon silt loam, difference in drainage conditions being responsible for the present differences in the two types.

To put this soil in good, productive condition requires artificial drainage, either by means of tile or ditches, the free use of ground

limestone and manure, and deep, thorough plowing. In its present condition it is best adapted to the growing of redtop.

A number of strips of Holly silt loam, a stream-bottom, alluvial soil, are included with the Guthrie silt loam on the map, on account of their small extent and close similarity to the Guthrie. They occupy flat, poorly drained bottoms in association with the Huntington silt loam. The soil is a gray, ashy silt loam, with brown and yellow mottling. The subsoil is a gray or drab, mottled clay. Concretions are present in the soil and subsoil, and are most abundant in the lower subsoil. The type is best suited to grass. Better drainage and the liberal use of limestone and phosphates are its foremost needs. The principal area of this type is the one at the confluence of Camp and Wolf Creeks.

COLBERT SILT LOAM.

The Colbert silt loam consists of a grayish-yellow silt loam, passing at about 6 inches into pale-yellow silty clay, which is underlain abruptly at about 18 to 20 inches by yellow, plastic, sticky, heavy clay, mottled with gray. The heavy, impervious subsoil is locally known as "hardpan." The type is derived mainly, through weathering, from chert-free limestone and shale.

Areas of Colbert silt loam occur along the lower slopes and in shallow valleys in the southwestern part of the county. They are usually bordered above by the soils of the Ashe and Lebanon series. The Colbert soil is used for the same crops and has about the same agricultural value as the Lebanon silt loam.

ROBERTSVILLE SILT LOAM.

The Robertsville silt loam occurs in comparatively small areas along the larger streams, particularly the St. Francis River. It occupies high, flat-topped terraces standing from 5 to 20 or more feet above the adjoining first bottoms and in most places separated from the latter by a distinct bluff. Locally it is known as "ash" or "crawfish" soil.

The surface soil is a light-gray to almost white, floury silt loam, passing at 6 to 8 inches into heavy silt loam or silty clay loam of about the same color. The subsoil below 15 to 18 inches is a plastic clay of a drab or bluish color, mottled with yellow and brown. Small concretions are found at the surface and in all the strata. The upper part of the subsoil is not readily pervious and is very effective in retarding the free movement of moisture either up or down.

Surface drainage is generally good, but the subdrainage is deficient and tends to make the soil cold and wet in spring and during rainy seasons. Most of the type is in pasture and mowing land, but

where the areas are sufficiently large they are cropped, mostly to corn. The yields are small. The first need of the soil is the addition of organic matter, followed by good underdrainage. In order to grow clover successfully it will be necessary to apply 1 to 3 tons of limestone per acre, as the soil is decidedly acid. Alsike clover will do better than red clover. Phosphate should be used with the organic matter. Cowpeas grow fairly well without special soil treatment, and timothy as well as redtop are well adapted to the type.

HUNTINGTON GRAVELLY LOAM.

The Huntington gravelly loam occurs in narrow strips along the smaller streams in the rough, hilly regions, and represents wash from the adjacent areas, more or less reworked by these streams. It is a light-brown to dark-brown gravelly loam with a reddish-brown to yellowish-brown gravelly loam subsoil, which passes into a bed of gravel at about 20 to 30 inches. The soil is about the same as the Huntington silt loam, except that there is present an abundance of gravel throughout the soil mass. At the heads of valleys and near the mouths of draws the content of gravel is frequently so high that the soil is nonarable. Most of the type occurs in such narrow strips that cultivation is difficult or impracticable. The cleared areas produce good crops of corn, but they are best suited to clover and grasses for pasture.

HUNTINGTON FINE SANDY LOAM.

The soil of the Huntington fine sandy loam is characteristically a brown, fine, sandy loam, which shows little change within the 3-foot section, except that the subsoil ordinarily is lighter colored, or mottled gray and brown, and is more sandy. As is generally true of alluvial soils, there are rather wide variations in texture, and both soil and subsoil may vary from silt loam to sandy loam. In general the percentage of sand is highest in the narrowest valleys, and nearest the stream bed. A few rounded gravel fragments are scattered through the soil mass. The areas are subject to destructive overflows, and during such times the character of the soil may be changed entirely.

The type occurs in stream bottoms in all parts of the county, but is confined almost entirely to the narrow, gorge-like bottoms. Much of the bottom land occurs in such narrow belts that it can not be farmed with heavy implements. This condition, together with the danger from overflow, limits the most efficient utilization of the type. The soil, however, is very productive and produces large yields of corn. The very narrow strips of alluvium can be utilized more profitably for truck than for field crops.

HUNTINGTON SILT LOAM.

The Huntington silt loam is a first-bottom soil developed along the streams in all parts of the county. The most extensive areas occur along the St. Francis River. The soil is mainly alluvium, but in some of the narrow valleys consists in part of colluvial material. In its typical development it is a brown, mellow, silt loam, continuing without much change throughout the 3-foot section, although, as a rule, the subsoil is somewhat lighter colored than the surface soil. In the more poorly drained flats and depressions the subsoil is frequently pale yellowish, yellowish brown, or mottled gray and brown, while in other places it has a reddish cast. Gravel and sand are sometimes found in the subsoil stratum. In general, that part of the type in the region of the Ashe soils averages lighter in color than elsewhere. In some of the narrower bottoms fragments of chert are present.

The Huntington silt loam is one of the most productive soils in the county. Corn is the principal crop, and yields of 40 to 70 bushels per acre are obtained in favorable seasons. Alfalfa does well in areas which are not flooded too frequently. A few of the depressed areas are in need of artificial drainage. The soil is easily maintained in a high state of productiveness, on account of the ease of growing soil-renovating crops, such as clover and cowpeas.

SUMMARY.

St. Francois County is located in the southeastern part of Missouri, in the eastern part of the Missouri Ozark region. It has an area of 458 square miles, 30 per cent of which is classed as improved land.

The surface features vary from gently rolling to semimountainous, and the county includes three distinct physiographic divisions. The region of granite hills in the southwestern part of the county is semimountainous, with rounded valleys of varying width between the peaks. The latter stand 500 to 700 feet above the lowland and rise 1,400 to 1,800 feet above sea level. The lowland basin in the eastern part of the county is gently rolling and forms the main agricultural region. The western and northern parts of the county are hilly, and in most places too broken to be farmed.

Lead mining is the most important industry in the central part of the county; of the total population of the county, reported as 31,403, in 1920, approximately 80 per cent is engaged in this industry. Farmington, the county seat, Bonneterre, Desloge, Elvins, and Leadwood are the largest towns.

General farming is carried on in the eastern part of the county. Corn, wheat, and grass are the principal crops. The raising of live stock is of chief importance in the hilly regions. It is probable that

the extension of the live-stock industry, together with a more liberal use of manures and fertilizers, would result in a more profitable agriculture throughout the county, particularly on all the soils of rather low productiveness.

The soils of St. Francois County are residual from limestone, sandstone, and granite, and on the basis of origin, topography, and agricultural value fall into four general groups.

The red limestone soils include the Hagerstown and Decatur silt loams, which are characterized by their brown and red color. They are the most productive and highly improved soils in the county, and are used for all the staple crops.

The Clarksville and Lebanon soils, derived from limestone, and the Tilsit soils, from sandstone, have gray surface soils and yellow or brown subsoils. The Lebanon and Tilsit silt loams are used for general farming, but are of low or only moderate productiveness. The Clarksville silt loam and gravelly loam have a hilly surface and are best suited for pasture.

The Ashe soils, derived from granite, are yellowish gray, with yellowish-brown subsoils. They are largely undeveloped, and only the silt loam type can be farmed.

The alluvial soils, developed in the stream bottoms, are brown in color and belong to the Huntington series. They are productive and used for corn and grass, but their area is small.

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[PUBLIC RESOLUTION—No. 9.]

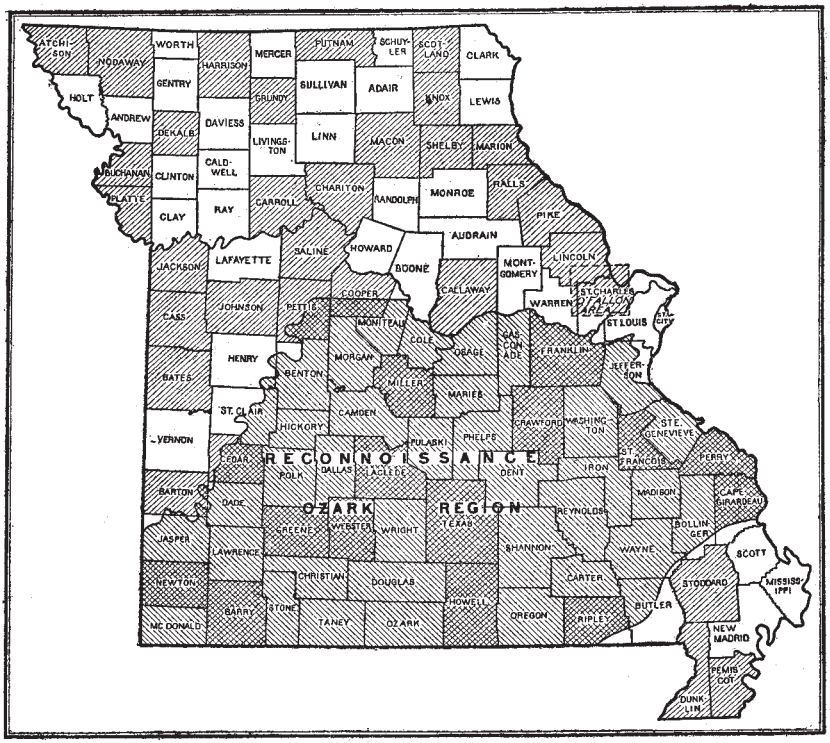
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Missouri.

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U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
MISSOURI
ST. FRANCOIS COUNTY SHEET

UNIVERSITY OF MISSOURI
AGRICULTURAL EXPERIMENT STATION
F.B. MUMFORD, DIRECTOR
M.F. MILLER, IN CHARGE SOIL SURVEY

R. 4 E. | R. 5 E. | R. 6 E. | R. 7 E. | R. 8 E.

T.38N. | T.37 N. | T.36N. | T.35N.

LEGEND

Ashe stony loam — Al
Ashe silt loam — Am
Clarksville gravelly loam — Cg
Clarksville silt loam — Cs
Glade phase — Cs
Colbert silt loam — Cl
Decatur silt loam — Ds
Guthrie silt loam — Gl
Hagerstown silt loam — H
Huntington gravelly loam — Hg
Huntington fine sandy loam — Hf
Huntington silt loam — Hs
Lebanon silt loam — Li
Robertsville silt loam — R
Tilsit fine sandy loam — Ts
Tilsit silt loam — Tl

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
Secondary roads and Trails
Railroads, Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church, Cemeteries
Mine or Quarry, Mine dumps, Made land
Bluff, Escarpment, Rock outcrop, and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U.S. township and section lines

RELIEF
(Printed in brown or black)

Contours, Depression contours
Prominent Hills, Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds, Intermittent lakes
Intermittent streams
Springs, Canals, and Ditches, Flumes
Swamp, Salt marshes
Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier date.

Hugh H. Bennett, Inspector, Southern Division.
Soils surveyed by H.H. Krusekopf, in charge, and E.W. Knobel and C.E. Deardorff of the University of Missouri.

BASE MAP IN PART FROM U.S. GEOLOGICAL SURVEY SHEETS

Scale 1/62500
1/2 0 1 2 3 4 Miles
Contour interval 20 feet.
Datum is mean sea level.

LITHO. A. HOEN & CO. BALTO. MD.

Field Operations
Bureau of Soils
1918.